

# Argonne National Laboratory

## GUIDE TO ACCESSING MULTIFILE MAGNETIC TAPES FROM FORTRAN PROGRAMS UNDER OS/360

by

Cynthia Chamot

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Applied Mathematics Division

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## ABSTRACT

This report gives ASP, JCL, and FORTRAN specifications for creating and retrieving information on multifile magnetic tapes. Also included are samples of DD cards that work, and lists of error indications that are obtained when these specifications are not followed. The emphasis is on using a different "data set reference number" for each file on tape to facilitate accessing arbitrary files of information.

## I. INTRODUCTION

### A. Discussion of the Problem

Each file of information on a magnetic tape is treated as a separate "data set" by OS/360, and a JCL DD card must be supplied for every file that is to be accessed. Proper specification of parameters for DD cards is complex, and the system imposes various restrictions that must be circumvented to avoid operator intervention. Although the DD card requirements can be simplified by transferring the files to disk in a previous job or job step, this transfer is not always desirable. Frequently, considerations of the machine time involved, the availability of disk storage space, and the frequency of use make the use of disks undesirable. When disks are used, the DD card specifications described in this report will still be applicable. These specifications are such that, usually, only the "volume serial number" on the ASP Setup card must be changed to agree with the library number of the tape to be mounted.

This report deals with accessing files of information either systematically (Method 1) or arbitrarily (Method 2) from FORTRAN IV programs running under OS/360 with ASP in control. The FORTRAN ddnames for which DD cards are needed are indicated for both methods of referring to multifile tapes. Parameters for ASP Setup cards and for JCL DD cards are described, and specifications are given for the appropriate parameters for accessing the first file on a tape and also for the two methods of accessing subsequent files on the same tape. There may be either formatted or binary information on seven- or nine-track tapes with or without standard IBM labels. FORTRAN coding requirements are also considered.

Multifile magnetic tapes may be processed efficiently under OS/360 by following the specifications given in this report. Some of the specifications do not have to be given exactly as indicated, but this report provides specifications that will work, rather than complete information about all

possible uses of available IBM parameters. The conclusions given in this report are based on an extensive study made by running under the Attached Support Processor (ASP) on the Argonne National Laboratory IBM System 360 computer complex (075 and 050) using the FORTRAN H compiler (OPT = 00) with releases 12 and 13 of OS/360.

## B. Two Methods of Accessing Data Sets on Multifile Tapes from FORTRAN Codes and the Associated FORTRAN Ddnames

In FORTRAN codes, one may refer to the files, or data sets, on a tape either by one "data set reference number" (e.g., 51), or by a series of such numbers (e.g., 51, 52, 53, ...). A "FORTRAN sequence number" of 001 is normally associated with the first file on tape referenced by a particular data set reference number; and FORTRAN sequence numbers of 002, 003, ..., are associated with the additional files referenced by that data set reference number in the FORTRAN program. The ddnames for FORTRAN codes consist of combinations of the data set reference number and the FORTRAN sequence number (e.g., FT51F001).

*METHOD 1. One data set reference number is convenient to use when creating a tape of several files or when reading such a tape systematically. Thus, DD cards should be provided for a series of FORTRAN sequence numbers associated with the same data set reference number (e.g., FT51F001, FT51F002, FT51F003, ...).*

*METHOD 2. A series of arbitrary data set reference numbers is convenient to specify each file when reading information from arbitrary files on tape. In this case, the system routines automatically reposition the tape forward or backward as necessary. A DD card would then be required for each data set reference number with a FORTRAN sequence number of 001 (e.g., FT51F001, FT52F001, FT53F001, ...).*

In both methods, the "data set sequence number" of the LABEL parameter on the DD card determines which file is to be used. A particular file on tape may be referenced by any number of DD cards; conversely, DD cards need be supplied only for the files of interest for a particular job.

## II. ASP SETUP CARD PARAMETERS FOR MULTIFILE TAPES

When running under ASP, a Setup card is required for each magnetic tape used by the job. As indicated in the ASP Applications Programmer's Manual,<sup>1</sup> the format of the card is: /\*SETUP DDNAME=ddname, DEVICE=type-of-unit, ID=(option 1, option 2, option 3, option 4).

The ddname is normally the DDNAME for the first file of interest on the tape (e.g., FT51F001), but it may pertain to any file. The stepname may not qualify the ddname by preceding it. Thus, when a job runs under ASP, the same ddname cannot be used to refer to different tapes in different steps of the same job.

The type-of-unit parameter is normally either 2400-7 for a seven-channel tape, or 2400-9 for a nine-channel tape. Alternate parameters are TAPE and



2400 for either type of tape, and 2400-1 for seven-channel tape and 2400-2 for nine-channel tape; but these lead to ambiguities, and their use is not recommended. The standard OS/360 tapes are nine-channel, so normally DEVICE=2400 should be specified.

The ID parameters should be as follows:

*Option 1* is normally a six-digit external library number of the tape to be mounted. If a scratch tape is to be used, this field is omitted. When a tape with a standard label is used and saved, this number appears toward the end of the printed output for the job in the message:

```
IEF280I  K  184, 123456, jobname.
```

This number should be the same as the library number assigned to the tape when the label was generated by a Utility on a previous occasion. Also, for unlabeled tapes, only the tape-unit drive number (e.g., 184) and jobname appear.

*Option 2* specifies whether the file-protect ring should be left in the tape. RING must be specified if the tape is to be written on. NORING is normally specified to prevent accidentally writing on an input tape. However, to minimize operator intervention, RING should be specified when a backup tape is available.

*Option 3* is normally SAVE to ensure that the tape is dismounted and saved at the end of the job. NOSAVE would only be appropriate if the tape were to be used for temporary storage. Normally a disk would be better for this purpose.

*Option 4* is either SL for standard label tapes, or NL for unlabeled tapes. Standard labels should be used wherever possible. The system recognizes labeled tapes and will not allow such a tape to be mounted and referenced as an unlabeled tape. The converse is also true, even for scratch tapes.

### III. JCL DD CARD PARAMETERS FOR MULTIFILE TAPES

#### A. General Comments

As indicated in the FORTRAN IV(H) Programmer's Guide,<sup>2</sup> each file of information accessed on a tape must have a DD card associated with it. The format for DD cards is given in the Job Control Language Manual<sup>3</sup> as follows:

```
//GO.ddname DD list of parameters and subparameters.
```

As indicated in Section I, FORTRAN ddnames are of the form FTrrFsss, where rr is the data set reference number and sss is a FORTRAN sequence number, and the ddnames for which DD cards are required depend upon whether the files on tape are accessed systematically (Method 1) or arbitrarily (Method 2) by the FORTRAN code. (See Section IV.A.)

There are basically two types of parameters and/or subparameters. Those written *with* = signs are of the "keyword" type and may be given in any order. Those written *without* = signs are of the "positional" type and must be given in a certain order. The DD card parameters for tapes are DSNAME=, UNIT=, VOLUME=, LABEL=, DISP=, and DCB=. These may be given in any order, as may the subparameters for the DCB parameter; the positional subparameters for the DISP, LABEL, and VOLUME parameters must be given in the prescribed order, or a comma must be inserted to indicate one is missing, e.g., DISP=(OLD,PASS); LABEL=(OL,SL); and VOLUME=(,RETAIN). If only a keyword parameter is to be specified for the VOLUME parameter, the others may be omitted completely as in VOLUME=SER=xxxxxx or in VOLUME=REF=\*.ddname.

B. JCL DD Card Parameter Specifications for the First File on Tape or the First File To Be Accessed

As indicated in Section A above, the pertinent parameters for tapes are DSNAME=, UNIT=, VOLUME=, LABEL=, DISP=, and DCB=. Appropriate specifications are described below.

1. DSNAME= is followed by a dsname (data set name) to identify the file of information (e.g., FILE1). If a tape is to be saved or passed from one job step to the next, a dsname must be supplied. *If information is to be read from a labeled tape, the dsname must be the same as the one used in creating the file.* Actually, if a dsname is not specified and one is needed for creating data sets to be kept, names such as AAAAAAAA.00000213, AAAAAAAA.00000214, etc., are obtained for successive files on tape.

A problem arises when a labeled scratch tape already has the same dsname as is to be applied to the tape. The system objects to writing over such a tape, and operator intervention is required to mount a different tape.

2. UNIT= is followed by a name specifying the type of tape drive as either

2400 for nine-channel tapes (corresponds to 2400-9 on Setup card)

or

2400-2 for seven-channel tapes with Data Conversion (see Ref. 4).

Alternate names in use at our installation are TAPE9TRK for nine-channel tapes, and TAPE7TRK for seven-channel tapes.

This name is changed to the actual tape drive number (e.g., 184) in the printed output of the DD card for the job. The UNIT parameter must be included on the DD card for this first file to provide a place for the actual tape drive number to be inserted. Actually the unit parameter should be written as UNIT=(2400,,DEFER), but UNIT=2400 is sufficient when running under ASP.

3. VOLUME= is followed by the volume specification. When a job runs under ASP, this should simply be VOLUME=(,RETAIN). The RETAIN is necessary to avoid the problem of the system unloading the tape between files. No

matter how the files are referred to (see Methods 1 and 2 in Section I.B), even with ASP in control, the machine sits idle while the operator remounts the tape. If more than one such tape is being used for the same job, the trouble would be compounded. Although the IBM OS/360 manuals<sup>2,3</sup> indicate that RETAIN is only used to keep tapes mounted from one job step to the next, the volume specification was most effective in keeping a tape mounted for later use within the same job step.

If ASP were not in control, it would be necessary to include the library number of an input tape as in `VOLUME=(,RETAIN,SER=123456)`; but under ASP, the number from the Setup card gets incorporated as the volume serial number in the printed output for the DD card. Omitting this number from the DD card means it is only necessary to change the number on the Setup card to specify the proper library tape.

PRIVATE could be specified as the first parameter, but it need not be specified for tape units; when it is specified, it causes tapes to be unloaded (demounted) between data sets even though RETAIN is specified. See additional comments on demounting tapes under the `DISP=` parameter below.

4. `LABEL=` is followed by two parameters. The first parameter is a data set sequence number, which determines which file on tape is to be associated with the ddname on the DD card. When only one file is needed for the job, that file number can be given here. Thus, this file number should be either 01 or the number of the first file to be accessed on the tape.

The second parameter must be either SL or NL to specify that the tape has either a standard label or no label on it. As indicated in Section II, a tape with a standard label cannot be accessed as an unlabeled tape, and vice versa. (For BLP to be a meaningful parameter, the system must have a built-in procedure to bypass label processing.) Thus, `LABEL=(01,SL)` would specify the first file on a tape with a standard label. Actually, for the first file, the 01 may be omitted.

Three additional specifications may be used. These are `RETPD=nnnn`, `EXPDT=yyddd`, and `PASSWORD`, but these are not usually necessary for tapes.

5. `DISP=` is followed by two parameters specifying status and disposition.

The first parameter tells whether the data set is OLD or NEW, where NEW must be used to create data sets and OLD must be used when the data set is already on tape. MOD may be specified instead for existing data sets to which additions are to be made during the job; but for multifile tapes, only the last file on tape can be modified in this manner.

The second parameter tells the system to KEEP the tape containing the data set, PASS it to another job step, or DELETE (i.e., release) the tape in the case of a scratch tape used for temporary storage. Thus, `DISP=(OLD,KEEP)` would specify an existing input data set to be kept at the end of the job step.

If RETAIN is not present as a VOLUME parameter, KEEP causes the tape to be demounted between data sets referred to by different data set

reference numbers. Actually, KEEP is not necessary under ASP since the tape will always be kept if SAVE is specified on the Setup card. Two more alternatives for the second parameter are CATLG and UNCATLG, but they are not normally used for data sets on tape.

If no DISP=parameter is specified on the DD card, the default parameters of DISP=(NEW,DELETE) are assumed.

6. DCB= is followed by the Data Control Block Information. This consists of five keyword-type subparameters, RECFM=, LRECL=, BLKSIZE=, DEN=, and TRTCH=, for accessing magnetic tapes from FORTRAN codes. If an appropriate DCB specification is already given on another DD card, simply use either DCB=\*.ddname or DCB=\*.stepname.ddname to refer back to the appropriate DD card. The DCB parameter may be omitted completely on two occasions: if either the FORTRAN default options (e.g., RECFM=U, BLKSIZE=800 for formatted I/O) are satisfactory, or the DCB information is already on the tape, as in the case of an input data set on a standard labeled tape. Actually, it is advisable to omit the DCB in this last case, since the DCB subparameters must agree exactly with those on a labeled input tape. Additional information on the subparameters is contained in the FORTRAN IV(H) Programmer's Guide.<sup>2</sup>

a. RECFM= is followed by specifications for the type of record format used on the tape. Use either F, U, or V to specify whether records are of fixed, undefined, or varying length, and possibly A to specify ASA carriage control and/or B to specify blocking and buffering as described below.

When tape records are of different lengths, U or V may be used, but U is more commonly specified. When V is used, additional information is incorporated into the records, so V can only be used to create data sets and to read information written with V specified. V must be used for reading unformatted (binary) information.

Of the three types, fixed-length records are generally handled most efficiently, but every record of an input tape must be of the same length. When fixed is specified for creating data sets, logical records of different lengths are padded as necessary to conform to the LRECL and/or BLKSIZE specifications.

B should also be specified if blocking is desired (e.g., RECFM=VB). Several logical records will then be combined to make one physical record. Much space is wasted by writing short physical records on tapes, since there is a 3/4-in. gap between each pair of physical records, and jobs should run faster when DCB specifications include RECFM=B and a large number for BLKSIZE.

Blocking is undesirable in two situations. One is if the FORTRAN code contains BACKSPACE statements, since a physical record instead of a logical record will be involved. The usual intent is to backspace a logical record, and it would be difficult to foresee the blocking arrangement when writing a FORTRAN program. The other instance arises when a program is being debugged. It is usually helpful to see every line of output that has been generated by the code in order to tell what the code was doing when it got into trouble. If blocking is allowed, one or more lines may not appear when a program terminates abnormally.

A should also be specified if the output is to be printed under carriage control so the pages are formatted properly (e.g., RECFM=FA). If A is omitted, the first character in each record is treated as data to be printed instead of as an ASA carriage control character.

b. LRECL= is followed by the maximum logical record length in bytes. This is the largest<sup>†</sup> record that will be read or written by a single FORTRAN statement. To obtain card images, set this to 80<sup>†</sup> or, if printed output is desired, to 133.<sup>†</sup>

c. BLKSIZE= is followed by the maximum blocksize in bytes ( $\leq 32760$ ). A buffer storage area of this size is then used for processing the physical records. This is the upper limit on the number of bytes that may make up a physical record and should be a multiple<sup>†</sup> of LRECL (if present) to achieve efficient buffering and blocking of output. If no blocking is desired, use the same number<sup>†</sup> for this as for LRECL.

d. DEN= is followed by 0, 1, or 2, corresponding to the tape densities of 200, 556, or 800 bpi. This parameter may be omitted for standard IBM tapes. DEN=1 would normally be used for seven-channel tapes.

e. TRTCH= is followed by an indicator for the transfer of data between the computer and the tape in the case of *seven-track tapes only*. The characters that may be used are E, T, and C.

Odd parity is assumed, unless E is present to specify even parity for the tape. Odd parity is normally used for binary tapes, even parity for BCD tapes.

A T indicates that the "Translate Feature"<sup>††</sup> is to be used; thus BCDIC characters encountered on tape are translated into EBCDIC characters for input. Also, information to be output is translated into BCDIC so it can be represented properly in the six bits available for each character on seven-track tapes. The letter T should *not* be used for binary data.

A C indicates that the "Data Conversion Feature"<sup>††</sup> is to be used. With the C, there is a one-to-one correspondence between bits in the machine and bits on tape, as is appropriate for the transmission of binary data. Without the C, six bits on tape correspond to one byte of eight bits in the machine, as is appropriate for character transmission. Thus TRTCH=ET is normally specified for formatted characters, and TRTCH=C is specified for binary information.

#### C. JCL DD Card Parameter Specifications for the Additional Files of Information to be Accessed

The pertinent parameters for accessing additional files of information on the same magnetic tape are DSNAME=, UNIT=, VOLUME=, LABEL=, DISP=, and DCB=. Specifications are given below for associating a previous *ddname* with either the volume parameter or the unit parameter to indicate that the additional files are on the same tape. The emphasis is on using the volume

<sup>†</sup>Allow four additional bytes if V is specified for RECFM.

<sup>††</sup>See the IBM manual<sup>4</sup> for the 2816 tape control.

parameter for this purpose, since the specifications for this parameter are more standard and less restrictive than those for the unit parameter.

Specifications for the other parameters are generally similar to those described above for the first file, but differences are noted below for each. In some cases, a parameter specification may be omitted completely. (See Appendix A for sample DD card specifications.) Only the *ddname* in the name field, the *dsname*, and the data set sequence numbers must change in going from one file to the next.

1. DSNAME= is followed by a unique *dsname* to identify the data set (e.g., FILE2) as indicated in B.1 above.
2. UNIT= may be omitted if the volume parameter is used to indicate the source of the data set. Otherwise, use UNIT= AFF = *ddname* to indicate that the same unit is to be used for this file as was used for the first file on tape. As indicated in B.2 above, it is not necessary to state UNIT=(,DEFER) when running under ASP.
3. VOLUME= is followed by the volume specifications. If the volume parameter is used to indicate where the data set may be found, specify VOLUME=(,RETAIN,REF=\*.*ddname*). The *ddname* used here is the same as that used for the first file on the tape. This indicates that the same volume is to be used for this data set as was specified for the first file on the tape.

If the unit parameter is being used to indicate where the data set may be found, VOLUME=(,RETAIN) must still be specified as described in B.3 above.

However, it is preferable to use the volume parameter instead of the unit parameter since (1) it is more correct to specify the tape volume on which the additional data sets reside than to specify a device that reads tapes; (2) the DD card format is simpler, since the volume parameter must be present anyway, while the unit parameter may be omitted completely when running under ASP; (3) an asterisk is included in the REF specification (this is consistent with other DD card specifications that refer back to information on other DD cards); and (4) in the volume specification, it is possible to refer back to the *ddname* for either the first file on the tape or for a preceding file, whereas the unit specification must refer back to the first file.

4. LABEL= is followed by two parameters, as described above in B.4, to determine which file on tape is to be associated with the data set and to specify that the tape has a standard label or no label. Thus LABEL=(06,NL) would specify the sixth file on an unlabeled tape.

5. DISP= is followed by two parameters as described above in B.5 to specify the status and disposition of the data set. Normally the statement reads either DISP=(OLD,KEEP) or DISP=(NEW,KEEP). If ASP is not in control, KEEP must be used for all the files of a tape that is to be kept, since there is no way of telling which file might be involved when a job terminates on the machine; and if PASS were specified instead of KEEP for that file, then the tape would *not* be kept automatically.



6. DCB= contains the data control block information as described above for the first file accessed on a tape. If the same data control block information applies to all files on a particular magnetic tape, it is correct either to repeat the DCB given for the first file accessed, or to refer back to it by specifying \*.ddname.

#### IV. FORTRAN CODING CONSIDERATIONS

##### A. Use of the FORTRAN I/O Statements for the Two Methods of Accessing Information on Multifile Tapes

There are five FORTRAN input/output (I/O) statements:

```
READ (n,format,END=#,ERR=#)list
```

```
WRITE (n,format)list
```

```
ENDFILE n
```

```
REWIND n
```

```
BACKSPACE n.
```

These statements all refer to data sets, or files of information on tape, by a data set reference number, n. (See the FORTRAN IV Language manual.<sup>5</sup>) In general, n must be  $\geq 10$  since the single-digit data set reference numbers are used by the IBM System.

The END and ERR specifications give statement numbers in the FORTRAN code indicating what to do if an end-of-file or a parity error is encountered when reading a tape. These specifications may be omitted entirely, but then the job will be terminated when either of these conditions occur. The format and/or list specifications may be omitted as appropriate. For example, no format would be given for binary information.

The FORTRAN statement BACKSPACE n may be used at any time to go back one *physical* record on the tape. However, if this feature of FORTRAN must be used, blocking should *not* be specified as part of the DCB information on the DD card. (See Section III.B.6.a.) Then each physical record will contain exactly one logical record, and there will be no problem.

##### 1. FORTRAN I/O Statements to Use for Creating and Retrieving Information on Tape by Method 1

When files are accessed sequentially using Method 1 (described in the Introduction), the same value of n is used throughout the program. If n = 51 and the first three files were to be accessed, then DD cards would be required for ddnames of FT51F001, FT51F002, and FT51F003, with the first LABEL subparameters specified as 01, 02, and 03, respectively.

Method 1 is only appropriate for reading and writing data in a systematic sequential manner. If it is necessary to go back to the beginning of

a file or to skip around to other files in a random fashion, Method 2 should be used as described under 2 below.

a. When creating information on a tape under Method 1, the `WRITE(n,...` statement writes information on the tape, and the `ENDFILE n` statement establishes the end of each data set by writing an end-of-file mark on tape. It is *not* correct to execute two `END FILE n` statements in a row so as to produce an empty data set.

b. When retrieving information from a tape under Method 1, the `READ(n,...` statement reads the information on tape, and the FORTRAN program must then keep track of the tape's position. The FORTRAN program must also test for end-of-file marks, and arrange to continue when these are encountered, by including the `END=#` specification in the `READ` statement. The `REWIND n` statement repositions the tape back at the beginning of the first file on tape. It *is* permissible to rewind a tape even if it has not been used.

## 2. FORTRAN I/O Statements to Use for Creating and Retrieving Information on Tape by Method 2

When FORTRAN programs access files arbitrarily under Method 2 (described in the Introduction), a different value of `n` is used to specify each file on tape. The value of `n` would normally be incremented in going from one file to the next. Thus, the *i*th file could be accessed by setting `n` equal to  $(50 + i)$  and using JCL DD cards for the ddnames `FT51F001`, `FT52F001`, `FT53F001`, ..., with  $i = 1, 2, 3, \dots$ , used for the data set sequence numbers in the LABEL parameters.

Method 2 may be used as well as Method 1 for writing information on tape, although Method 1 is more straightforward for creating tapes. Information on such tapes *can* be accessed by using Method 2 later, but it is most convenient to use a single method all the way through, so only one set of DD cards must be made up. Thus, Method 2 is to be preferred since arbitrary files may be accessed and it is simple to go back to the beginning of a file.

The `REWIND n` statement *must* be used to "close" a data set referred to by one data set reference number before going on to another data set reference number to refer to information on the same tape.

a. When creating information on tape under Method 2, the `WRITE(n,...` statement writes the information on tape, the `ENDFILE n` statement may be used to establish the end of the data set by writing an end-of-file mark on tape, and the `REWIND n` statement *must* be used to close each data set after it is written. Then the value of `n` may be incremented and another file of information written, and the data set closed by use of the `REWIND` statement, where `n` always refers to the file just written. Actually, it should not be necessary to execute an `ENDFILE n` statement after writing each data set, since the system routines will supply the necessary end-of-file mark when closing the data set. The data sets must be created sequentially as for Method 1.

b. When retrieving information from a tape under Method 2, the first `READ(n,...` statement causes the tape to be positioned properly by the system

routines, so the first record of the *i*th file on tape is read as desired. Then, when all the desired information has been read from that file, the FORTRAN statement `REWIND n` *must* be executed to close one file before going on to another file on the same tape, where *n* refers to the file just read. The value of *n* may then be modified as desired and a `READ(n,...)` statement executed as above to start reading information at the beginning of any desired file. You *cannot* come back to your previous position within a file once it has been closed. As the IBM system is presently implemented, when a file is closed it is not actually rewound. Thus, you can proceed efficiently from one file to the next. A `REWIND` statement may be executed for any file at any time.

## B. Other IBM System 360 Tape-handling Information

### 1. Restrictions on the Minimum Record and Data Set Lengths

For a tape to be processed by the IBM System 360, each record of information must be at least 18 bytes long. Also, since a data set cannot be empty, two consecutive end-of-file marks cannot be written or recognized by the System. Any attempt to read such tapes generated elsewhere results in a "Permanent I/O Error" diagnostic with the resultant abandonment of the entire job.

### 2. Supplementary Information for Binary Tapes

Unformatted (i.e., binary) information can only be accessed if the varying type of record format is specified. (See Section III.B.6.a.) Extra bytes of information must thus be included on the tape proper. Since binary tapes generated elsewhere do not normally include such information, some other programming language must be used to process the tapes.

### 3. Notes on Processing Seven-channel Tapes

Information on seven-channel tapes may be processed in a variety of ways as described under the `TRTCH` subparameter of the DCB specification. (See Section III.B.6.e.) Thus there should be no problem with seven-channel tapes, but note the restrictions for all tapes under 1 and 2 above.

## V. WARNINGS

The following restrictions must be observed in any case. They are re-stated here because their vital nature is not indicated conclusively in the IBM manuals.

1. `RETAIN` *must* be included as a volume subparameter in order to avoid operator intervention, even when using the same data set reference number to refer to each file on tape systematically. (See Section III.B.3.)

2. The `DSNAME` on the DD card provided for each data set *must* match the `DSNAME` for each file on a standard labeled input tape. (See Section III.B.1.)

3. RECFM=V *must* be used to specify the varying type of record format for tapes with unformatted (i.e., binary) information. (See Section III.B.6.a.)

4. The REWIND statement *must* be used to "close" a file (i.e., data set) before going on to the next file on tape when arbitrary files are being referred to by different data set reference numbers. (See Section IV.A.)

5. The BACKSPACE statement *must not* be used in conjunction with tapes containing blocked records. (See Section IV.A.)

6. NORING *must* be specified on the ASP Setup card in order to avoid operator intervention before each file is accessed. (See Section II.)

Although RETAIN would always be necessary, some of the above restrictions may not always apply. For example, our ASP has been modified to automatically reply to the error message that normally results when a tape is mounted without its "write-enable" ring for use with a FORTRAN program.

## APPENDIX A

Sample Control-card Specifications1. Specifications for DCB Subparameters on JCL DD Cards

The following specifications may be used for either nine-channel (800-bpi) or seven-channel (556-bpi) tapes, but the DEN and TRTCH parameters should only be included for seven-channel tapes.

a. *Card Images, Unblocked*

RECFM= $\begin{Bmatrix} F \\ U \end{Bmatrix}$ , LRECL=80, BLKSIZE=80, TRTCH=ET

b. *Card Images, Blocked (10 cards per physical record)*

RECFM=FB, LRECL=80, BLKSIZE=800

c. *Lines To Be Printed, Unblocked*

RECFM= $\begin{Bmatrix} FA \\ UA \end{Bmatrix}$ , LRECL=133, BLKSIZE=133

d. *Lines To Be Printed, Blocked (six lines per physical record)*

RECFM=FBA, LRECL=133, BLKSIZE=798

e. *Unformatted Binary Information, Unblocked*

RECFM=V, LRECL=24, BLKSIZE=28, TRTCH=C

f. *Unformatted Binary Information, Blocked*

RECFM=VB, LRECL=24, BLKSIZE=100, TRTCH=C

This last specification would be appropriate for logical records of five 32-bit words of information blocked with four logical records to a physical record on tape.

2. Specifications for ASP SETUP and JCL DD Cards

In the following sample cards, the assumptions are made that in the FORTRAN program the data set reference number, *n*, is 51 for accessing information in the first file and also for accessing additional files systematically (Method 1), and *n* is 50 + *i* for accessing the *i*th file arbitrarily (Method 2). For bracketed items, the *first ddname* is used in Method 1 and the *second ddname* is used in Method 2. Appropriate specifications must be added for the indicated DCB subparameters. Specifications are given for three files of information, and cards for each additional file are similar to those for the third file in each case, but with the underlined values changed as appropriate.

a. *A Nine-channel Output Tape with a Standard Label (800 bpi)*

```

/*SETUP DDNAME=FT51F001,DEVICE=2400-9,ID=(,RING,SAVE,SL)
//GO.FT51F001 DD DSNAME=FILE01,LABEL=(01,SL), C
// DISP=(NEW,KEEP),VOLUME=(,RETAIN),UNIT=2400, C
// DCB=(RECFM= ,LRECL= ,BLKSIZE= )
//{FT51F002} DD DSNAME=FILE02,LABEL=(02,SL), C
//{FT52F001}
// DISP=(NEW,KEEP),VOLUME=(,RETAIN,REF=*.FT51F001)
//{FT51F003} DD DSNAME=FILE03,LABEL=(03,SL), C
//{FT53F001}
// DISP=(NEW,KEEP),VOLUME=(,RETAIN,REF=*.FT51F001)

```

b. *A Nine-channel Output Tape with No Label (800 bpi)*

Cards are prepared as above, but each SL is replaced with NL.

c. *A Nine-channel Input Tape with a Standard Label (800 bpi)*

```

/*SETUP DDNAME=FT51F001,DEVICE=2400-9,ID=(012345,NORING,SAVE,SL)
//GO.FT51F001 DD DSNAME=FILE01,LABEL=(01,SL), C
// DISP=(OLD,KEEP),VOLUME=(,RETAIN),UNIT=2400
//{FT51F002} DD DSNAME=FILE02,LABEL=(02,SL), C
//{FT52F001}
// DISP=(OLD,KEEP),VOLUME=(,RETAIN,REF=*.FT51F001)
//{FT51F003} DD DSNAME=FILE03,LABEL=(03,SL), C
//{FT53F001}
// DISP=(OLD,KEEP),VOLUME=(,RETAIN,REF=*.FT51F001)

```

Note that the dsnames must match those used in creating the tape.

d. *A Nine-channel Input Tape with No Label (800 bpi)*

Cards are prepared as above, but each SL is replaced with NL and the DCB is specified on a continuation card between the DD cards for the first file. The DCB specification must be consistent with the way the tape was written, though the blocking may be different. There is no restriction on the dsnames given on the DD cards or on the volume identification given on the SETUP card, but the dsnames should be unique.

e. *A Seven-channel Output Tape with No Label (556 bpi)*

```

/*SETUP DDNAME=FT51F001,DEVICE=2400-7,ID=(,RING,SAVE,NL)
//GO.FT51F001 DD DSNAME=ONE,LABEL=(01,NL), C
// DISP=(NEW,KEEP),VOLUME=(,RETAIN),UNIT=2400-2, C

```



```

//          DCB=(RECFM=      ,LRECL=      ,BLKSIZE=      ,DEN=1,TRTCH=  )
//{FT51F002} DD  DSNAME=TWO,LABEL=(02,NL),          C
//{FT52F001}

//          DISP=(NEW,KEEP),VOLUME=(,RETAIN,REF=*.FT51F001)
//{FT51F003} DD  DSNAME=THREE,LABEL=(03,NL),          C
//{FT52F001}

//          DISP=(NEW,KEEP),VOLUME=(,RETAIN,REF=*.FT51F001)

f.  A Seven-channel Input Tape with No Label (556 bpi)

/*SETUP DDNAME=FT51F001,DEVICE=2400-7,ID=(012345,NORING,SAVE,NL)
//GO.FT51F001 DD  DSNAME=FIRST,LABEL=(01,NL),          C
//          DISP=(OLD,KEEP),VOLUME=(,RETAIN),UNIT=2400-2,          C
//          DCB=(RECFM=      ,LRECL=      ,BLKSIZE=      ,DEN=1,TRTCH=  )
//{FT51F002} DD  DSNAME=SECOND,LABEL=(02,NL),          C
//{FT52F001}

//          DISP=(OLD,KEEP),VOLUME=(,RETAIN,REF=*.FT51F001)
//{FT51F003} DD  DSNAME=THIRD,LABEL=(03,NL),          C
//{FT52F001}

//          DISP=(OLD,KEEP),VOLUME=(,RETAIN,REF=*.FT51F001)

```

The DCB specification must be consistent with the way the tape was written, though the blocking may be different. There is no restriction on the dsnames given on the DD cards or on the volume identification given on the SETUP card, but the dsnames should be unique.

## APPENDIX B

Sample FORTRAN Program

The following FORTRAN program writes seven files of information with IT (the data set reference number) taking on values of 51, 52, ..., 57. Then the information is retrieved from the files in the arbitrary order: 7, 4, 1, 2, and 5; and when an attempt is made to read a nonexistent eighth file, the job is terminated with the diagnostic IHC219I. After each file is written or read, it is closed by a REWIND statement before going on to the next file.

```

      DIMENSION IC(10)
      IT=50
      PRINT 5,IT
      DO 10 I=1,7
        IT=IT+1
        PRINT 5,IT
        PRINT 5,I
        PRINT 5,I
        PRINT 5,I
        PRINT 5,I
        WRITE(IT,5) I
5     FORMAT('0THIS IS NO.'I2)
        PRINT 5,I
        IC(I)=10
        ENDFILE IT
        PRINT 5,I
        REWIND IT
10    CONTINUE
        IK=1
        INC=-3
        PRINT 5,INC
15    CONTINUE
        PRINT 5,IT
16    READ (IT,20) (IC(I),I=8,10),IR
20    FORMAT(3A4,I2)
        PRINT 25,(IC(I),I=1,10),IR
25    FORMAT(7I4,3A4,I2)
        REWIND IT

```

```
IT=IT+INC
PRINT 5,IT
IF(IT.GT.50) GO TO (15,16),IK
IT=51
PRINT 5
30 IT=IT+1
INC=3
PRINT 5,INC
IK=2
GO TO 16
END
```

## APPENDIX C

Summary of the IBM S/360 Diagnostics Obtained When  
Improper Specifications Are Given for Accessing  
Information on Multifile Tapes

Type of Diagnostic	Possible Cause of Trouble
<u>Data Management Messages</u>	
IEC 101A M <sup>†</sup>	RETAIN was omitted from the VOLUME specification. Therefore the tape demounts each file and must be remounted.
IEC 102A F <sup>†</sup>	There is no write-enable ring in the tape, and one is needed; i.e., the program is actually attempting to write on the tape.
IEC 103D F <sup>†</sup>	There is no write-enable ring in the tape, and none is needed. No operator intervention is required with ASP modified appropriately.
IEC 111A M <sup>†</sup>	The tape has the wrong kind of label; i.e., an unlabeled tape is called for and the tape has a standard label, or vice versa.
<u>Job Scheduler Messages</u>	
IEF 117I	"Operand Continuation Message": There is an extra comma after the last parameter on a JCL DD card, and column 72 is punched.
IEF 147I	"Stmnt. Sequence Error": The stepname GO should qualify the ddname on the DD card for the first file on a tape, i.e., GO.FT51F001.
IEF 151I	"Illegal Field--Scan Resumed": A parameter specified on a JCL DD card is not recognized by the system. Check the spelling.
IEF 155I	"Improper Reference": The ddname REFERenced in the VOLUME specification is not defined, or the stepname GO was included incorrectly.
IEF 157I	"Continuation Indicated--Col. 72 Blank": There is a comma after the last parameter on a JCL DD card, and column 72 should also be punched.
IEF 212I	"DSNAME Field Has Level of Index Missing": A ddname should be REFERenced in a VOLUME specification instead of a dsname.

<sup>†</sup>Indicates that operator intervention is required as follows:

M: Mount the proper tape on the specified unit or device.

R: Remove the tape that is mounted, since it will not be accepted for the job.

F: Insert a ring in the tape if necessary, and type in the reply U.

Type of Diagnostic	Possible Cause of Trouble
<u>Job Scheduler Messages (Contd.)</u>	
IEF 233A M <sup>†</sup>	This message normally follows IEF 234A R to request that a different (labeled) scratch tape be mounted. The job should be canceled if it is an input tape.
IEF 234A R <sup>†</sup>	Either a labeled scratch tape already has the specified dsname on it, or the volume serial number on the JCL DD card is incorrect if it is an input tape.
IEF 244I	"Unable to Allocate from Available Devices": The ddname in the AFFinity specification of the UNIT parameter must always be for the first file.
<u>FORTRAN IV Object Program Messages</u>	
IHC 217I	The end of the data set was encountered while attempting to read more data, a data set being the same as a file of information.
IHC 218I	Although the records on tape could be <18 bytes long, this message is usually given when a fixed type of record format is specified in the DCB, but the input tape contains at least one record of a different length. Therefore, try changing F to U for the RECFM subparameter of the DCB.
IHC 219I	The program is trying to access information in a data set for which no DD card has been supplied.
<u>System Completion Codes</u>	
122	Time Exceeded: The Operator may have had to remount a tape repeatedly. If the correct tape is being used, be sure RETAIN is included in the VOLUME specification.
222	Operator Termination: Same as for 122 (Time Exceeded).
413	The program failed to close a data set before going on to a data set referred to by a different data set reference number on the same tape. FORTRAN programs must execute a REWIND statement to properly close out a data set in such cases.
513	The program failed to close a data set as described above for 413.
813	The dsname on an input tape does not match that specified for the data set on the DD card.

For further information on these and other diagnostics, see the IBM publication on messages and codes for OS/360.<sup>6</sup>

<sup>†</sup>See footnote on previous page.

## REFERENCES

1. *IBM System/360 Attached Support Processor System (ASP), Applications Programmer's Manual*, H20-0322.
2. *IBM System/360 Operating System, FORTRAN IV(H) Programmer's Guide*, C28-6602.
3. *IBM System/360 Operating System, Job Control Language Manual*, C28-6539.
4. *IBM System/360 Component Description, 2400-Series Magnetic Tape Units and 2816 Switching Unit*, A22-6866.
5. *IBM System/360, FORTRAN IV Language*, C28-6515.
6. *IBM System/360 Operating System, Messages and Codes*, C28-6631.



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